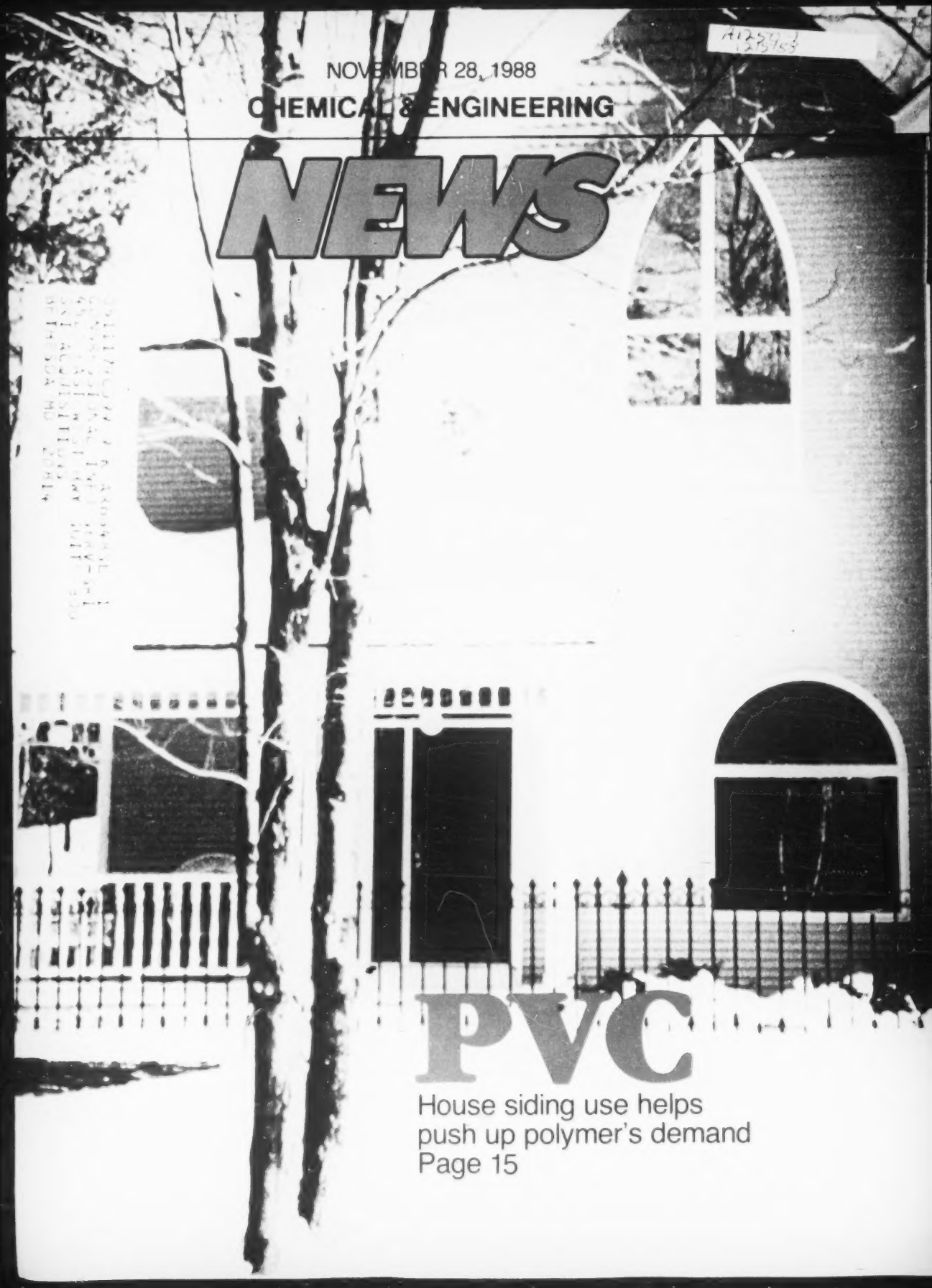
NOVEMBER 28, 1988
CHEMICAL & ENGINEERING

NEWS



PVC

House siding use helps push up polymer's demand
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CHEMICAL & ENGINEERING
NEWS
NOVEMBER 28, 1988

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News of the Week

■ **Canada's Prime Minister Brian Mulroney was returned to office last week, and, with a Conservative majority in the House of Commons, the way seems clear for approval of free trade agreement with the U.S.** **Page 4**

■ **NSF will provide $2 million over five years for novel program to promote collaborations between mathematicians and molecular biologists.** **Page 5**

■ **U.S. Patent & Trademark Office's automated patent system is set for first full production use in new PTO data center just opened.** **Page 5**

■ **Paul Gassman, Regents Professor of Chemistry at the University of Minnesota, has been elected ACS's 1989 president-elect.** **Page 6**

Cover: Photo courtesy of the Vinyl Institute

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News Focus

Four-year-old saga of Bhopal litigation has moved nearer to an end, with Indian Supreme Court considering an appeals court decision calling for Union Carbide to pay interim damages to victims. **Page 7**

Government

Plans for future federal regulatory actions are detailed in agenda published in *Federal Register;* proposed revisions to Superfund's guiding regulatory framework have been issued by EPA. **Page 19**

Science

New lead-strontium-copper oxides superconductors have unusual features, contain PbO-Cu-PbO sandwich not seen before; Elias J. Corey of Harvard University is honored with symposium. **Page 22**

Education

Oregon Graduate Center expects to double faculty and quadruple students over next five to eight years. **Page 26**

Technology

New family of silicone release coatings cuts production costs for pressure-sensitive adhesive labels and tapes. **Page 31**

Books

"The Art of Scientific Writing" by Ebel, Bliefert, and Russey thoroughly covers topic, uses examples drawn from chemistry. **Page 34**

Awards

ACS award winners: Parshall, Rapoport, Regnier, Schrader, Schreiber, Somorjai, Stewart, Szarek, and Taylor. **Page 39**

Business

Production capacity for polyvinyl chloride is increasing, owing to a rapid rise in PVC applications, such as siding and other architectural products. **Page 15**

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LETTERS

Fluoridation of water

SIR: I must say that the article on fluoridation by Bette Hileman (C&EN, Aug. 1, page 26) implies rather different conclusions than I have drawn, based on careful study of the data and the issues.

The author has accurately reported that the fluoridation of community water supplies has engendered highly emotional responses from a minority of the population and broad-based support from health professionals. Support has been based on the ability of fluoride to increase the resistance of teeth to decay, thus helping to prevent disease. There is abundant scientific evidence for the beneficial effects of fluoride dating back half a century and confirmed in numerous studies including very recent reports. With the improvements in oral health that have occurred, the amount of disease prevented by fluoridated drinking water today may be less than 50 years ago. Still, the fact remains that those who have had lifelong access to fluoridated drinking water experience less dental decay, on average, than those who have not had such access.

Historically, opposition to fluoridation has been based largely on constitutional issues and on a myriad of purported health concerns. The constitutional issues have been fully dealt with by a number of state supreme courts that have upheld fluoridation as legal and appropriate. The U.S. Supreme Court on several occasions has determined that there is no basis for a review of the state court decisions.

In terms of purported health concerns, there is much evidence to indicate that there is no scientific basis for concern and no credible evidence of harm that would justify abandonment of fluoridation as a valued public health measure. As Surgeon General, I have directed two scientific reviews of the effect of naturally occurring fluorides on human health. Although these studies were not targeted at the practice of community water fluoridation per se, it is clear from the evidence that at the level of fluoride that is recommended for community water systems, dental decay is significantly reduced and no deleterious side effects are experienced.

Hileman may have intended to present the issues in a neutral light, but she misses her mark. Little attention is accorded the massive amount of evidence that has documented the effectiveness and safety of fluoridation and thus the great public health benefits that have occurred at little cost to the taxpayer. Much emphasis is placed on allegations of harm, all of which have been substantively dealt with by scientific experts, the courts, and regulatory bodies at the state and national levels. The use of boldface headings, accusatory language such as "Health risks: more questions than answers" and "Promoters' style has fueled fluoridation controversy," and the use of photos of apparently crippled individuals from other parts of the world as an example of what fluoride could ostensibly cause in the U.S. fall below the standards of credibility and veracity and in no way could be viewed as objective journalism.

It is rare that there is total consensus about any issue that is brought before the public or, indeed, in science. However, general public debate is not the most appropriate forum for pursuing scientific truth. Scientific research and review by qualified experts can point to the best choices of health-promotion and disease-prevention measures, based on existing evidence. For methodological and other reasons such as random variation, the results of scientific investigations can never be expected to be 100% consistent. Yet with water fluoridation, the beneficial results have been markedly significant, consistent, and reproducible.

For my part, I will continue to support community water fluoridation and recommend it to communities as an effective public health measure. I will continue to encourage scientific inquiry into the role of fluorides in human health. And I will continue to review dispassionately the scientific evidence relevant to these considerations. I would encourage others to do the same.

C. Everett Koop, M.D.
Surgeon General

Editor's note: Surgeon General Koop's comments about the credibility, veracity, and objectivity of the C&EN article should be assessed in the light of questions raised by numerous scientifically qualified individuals and organizations about the fluoridation of drinking water supplies. These questions are largely concerned with present understanding of the impacts of fluoride on human health and with ambiguities over the efficacy of fluoridation as a tooth decay preventative in children.

The discussion of health risks in the C&EN article covers only topics that have been examined in detail by credible and responsible scientific organizations such as the National Academy of Sciences and the National Research Council of Canada. Like the C&EN article, reports from these groups do not advocate that fluoridation be discontin-

Demand for Architectural Products Helps Boost PVC Capacity

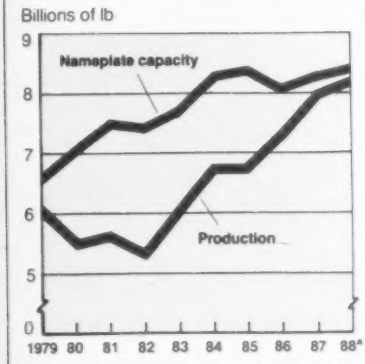
Rapid rise in use of vinyl products, including vinyl siding for home remodeling, sparks debottlenecking efforts and construction of new plants

Bruce F. Greek, C&EN Houston

Strong demand in architectural applications this year has led polyvinyl chloride producers to fully use all in-place plant capacity. Demand for vinyl siding and accessories has grown as a result of new developments in forming, coloring, and resistance to weathering, sparking overall growth in PVC consumption. The surge in new plant capacity coming on stream this year has shaped the outlook for PVC production during 1989, which could match or exceed the more than 5% increase forecast for 1988.

As of the end of August, consumption of PVC in vinyl siding and related products reached more than 470 million lb, up 12% over the same period of 1987. That consumption, however, is a distant second to the 2.2 billion lb made into pipe, one of the several end uses detailed by the Committee on Resin Statistics of the Society of the Plastics Industry. For all of 1988, siding and related products alone are expected to require more than 700 million lb of PVC, or about 9% of forecast U.S. consumption of more than 7.8 billion lb.

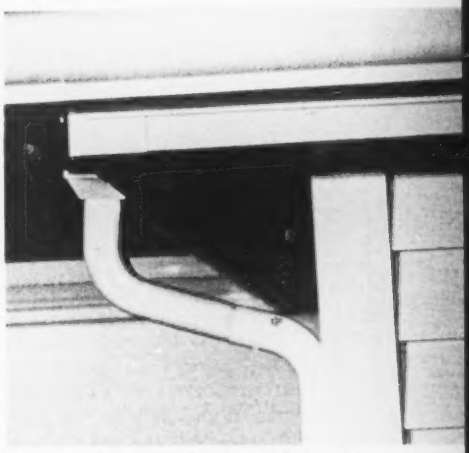
PVC capacity use soars after several-year lag



a Production estimate based on January through August data. **Sources:** C&EN estimates, Committee on Resin Statistics of the Society of the Plastics Industry

Most of the vinyl siding consumed goes on existing houses as part of repairs or maintenance to substitute for painting. Little of the vinyl siding is believed to be used on new houses or on commercial buildings. Rapidly rising selling prices of both new and existing houses in most parts of the country have led many home owners to spend more fixing up their houses instead of trying to move up to larger houses. Quality improvement in vinyl siding and smaller price increases than in aluminum siding are cited by industry sources as the major reasons for the rapid growth in demand.

Vinyl siding and PVC producers are unsure that more vinyl siding could be sold if more were available. Competition from other uses of PVC, some of which are growing faster than siding but from a smaller base, may be limiting siding output. For example, vinyl flooring made by calendering, such as conventional vinyl tile, consumed 11% more PVC through August this year than last year. Consumption of PVC in molded bottles was up more than 32%, to almost 150 million lb, and in film and sheet for packaging it was up more than 21%, to almost 225 million lb through August, according to SPI. Other PVC uses during the first eight months of 1988 generally have shown gains, except in pipe, wire and cable coverings, and some small uses.



Gutters, downspouts are a major part of PVC architectural products market

Serious limitations to PVC production during the first half of this year caused hard decisions on which specification resin would be produced to meet which end use. Shortfalls in output, compared with what might have been sold, resulted from limits on polymerization capacity, limited availability of monomer (vinyl chloride), and, in turn, limited availability of precursor (ethylene dichloride). Consequently, producers of PVC may have shifted output toward the higher-value resin forms and reduced output of resins with lower selling prices, such as pipe grades.

Pipe consumption of PVC indeed has slipped this year. After a good start, pipe demand turned down in March and slid more during the second quarter, as housing and commercial construction declined or made very few gains. At the

same time, inventories of finished pipe were reduced. More recently, the decline in pipe demand for PVC has slowed, with the August decline slightly under 1% compared with August 1987. No significant recovery is expected in the remainder of this year. For the year, pipe consumption will total 3.2 billion to 3.3 billion lb, down about 3.5% from 1987 consumption. Even so, pipe will account for more than 40% of total U.S. consumption of PVC.

A variety of causes have been suggested for the slowdown in demand for PVC in pipe. One is that a small shift from multifamily housing to more single-family units has reduced use of smaller-diameter PVC pipe in areas such as drain, waste, and vent piping. Another proposed cause relates to the relatively rapid increase in prices of PVC pipe resins. Current prices are 42 to 45 cents per lb, up from well below 30 cents per lb two years ago. The price increase has made ductile iron pipe less expensive in large diameter sizes, which are widely used in city water distribution systems. Easier handling and lower shipping costs, because of its lighter weight, offset the higher cost of PVC pipe to some degree, however.

Although demand has increased rapidly for PVC in vinyl siding and related products, such as window components, PVC use in packaging is also growing fast. Film and some sheet forms used in packaging required close to 300 million lb of PVC last year; this year these packaging uses may total close to 360 million lb, or nearly half the use in siding. Use in bottles for a variety of household products is growing even faster, but from a smaller base. In 1988, molded bottles will consume about 225 million lb of PVC, up from last year's consumption of 160 million lb.

Total PVC consumption in the U.S. this year of 7.8 billion to 8.0 billion lb would represent a 3% gain from 1987. Another 400 million to 500 million lb of PVC will be exported. The sum of uses will require a total production of 8.2 billion to 8.5 billion lb, up about 5% from slightly less than 8.0 billion lb produced in 1987. Because of the relatively large amount of new PVC and vinyl chloride capacity that either has come on stream in 1988 or is yet to be started up and because of additional capacity to be made available in 1989 (early enough to contribute significantly to production during the rest of 1989), production of PVC in 1989 could increase at least 500 million lb, or more than 6%.

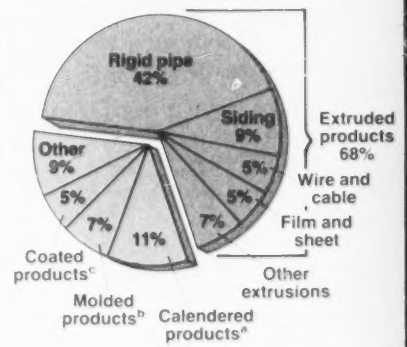
However, the outlook for PVC production and consumption faces several uncertainties. For example, a decline in housing and commercial construction in the next year could dampen demand for pipe resins even more than during this year. Demand for PVC pipe used in water systems involving government agency contracts would hold up better, because the longer lead and construction times of these projects would partly offset effects of any downturn. A downturn, however, likely would not dampen production of PVC as much as it would sales, since both producers and consumers may build inventories from the current low levels of about 10 days' production. Bringing inventories up to 30 days of production, the desired level on a historical basis, could add 5% to annual production.

Exports pose uncertainties in the outlook for consumption and production of PVC, although exports increased more than 9% during the first eight months of this year, to an annualized rate of about 480 million lb. That rate is 65% above the 1985 level of 292 million lb (the lowest level of the decade), according to SPI. Heightened business activity around the world, especially in the Far East, contributes to the currently strong export picture. But the outlook for exports remains cloudy, partly owing to economic uncertainties, but also because of uncertainty about when new capacity to make PVC will come on stream in other parts of the world, especially in the Far East.

Exports of PVC, of course, would be much larger than they now are, or have been, if the polymer were exported at the levels that PVC precursors are exported. In 1987, for example, more than 840 million lb of vinyl chloride were exported. Between 750 million and 800 million lb of PVC likely was made from the exported material. Additionally, more than 950 million lb of ethylene dichloride was exported in 1987. Between 500 million and 550 million lb of PVC could have been made from that ethylene dichloride. (Not all ethylene dichloride is used to make vinyl chloride and PVC; other uses may take 10% or more of the total in some export markets.)

To meet demand for PVC this spring, plants of all 13 producers were run at or above effective capacity. Similarly, the plants of eight vinyl chloride producers, many of whom make PVC, also were run full out to supply the monomer to fill both domestic and export demand. Most ethylene dichloride, vinyl chloride, and PVC plants have been expanded or are being expanded. Some of the capacity gained is in relatively small debottlenecking projects, but other projects are much larger, including some world-scale units on which construction has not yet begun but that are well into the planning and site selection stages. Because of numerous plant expansion projects in other PVC precursor chemicals and small expansions that are never announced, actual nameplate capacities for each of the

Rigid pipe and siding account for half of U.S. PVC use



1988 sales and captive use[d] = 7.9 billion lb

a Includes flooring and textile. b Includes bottles and pipe and tubing fittings. c Includes flooring, textile and paper coatings, protective coatings, and adhesives. d C&EN estimate; excludes exports. Source: Ernst & Whinney for the Committee on Resin Statistics of the Society of the Plastics Industry

compounds are difficult to determine. Some vinyl chloride plants have been expanded this year just as increased supplies of the monomer were needed to meet demand from PVC expansions. PVC expansions probably have been insufficient to meet demand, however, indicated by increased selling prices, only part of which can be attributed to the sizable increases in prices for ethylene and chlorine, the basic raw materials for PVC.

Early this year, in-place capacity to make vinyl chloride totaled about 8.7 billion lb. Work already was under way on several sizable expansions that added more that 500 million lb to capacity through the early summer. Other expansions completed this fall and still others scheduled to be completed by the end of the year will bring capacity at the beginning of 1989 to about 9.5 billion lb. So these expansions will have added almost 10% to vinyl chloride capacity in a year's time, a considerable amount of new capacity to have come on stream within a year.

In the most recent large vinyl chloride capacity addition, Dow Chemical added 240 million lb of capacity at the end of the third quarter to a plant in Plaquemine, La. That expansion is part of an ongoing program that will eventually add another 210 million lb of capacity to plants at Plaquemine and Freeport, Tex., giving Dow a nameplate capacity of about 2.2 billion lb in 1990.

Other producers, such as B. F. Goodrich Chemical, Borden Chemical, Georgia Gulf, and Vista Chemical, have added vinyl chloride capacity through incremental expansions this year. Expansions of vinyl chloride capacity normally entail addition to ethylene dichloride capacity as well. For some producers who have uses for ethylene dichloride other than making vinyl chloride, or who sell ethylene dichloride, capacity expansions may be larger than expected from the vinyl chloride expansion announcements.

Another major round of vinyl chloride expansion is beginning. In addition to debottlenecking projects, such as Dow's program and those of other vinyl chloride producers, Occidental Chemical is in a joint venture with Marubeni Corp. of Japan to build a 1 billion lb-per-year vinyl chloride unit on the Gulf Coast, with construction scheduled to start in the second quarter of 1989 and completion slated for late 1990. Occidental also has plans under way to increase capacity of an existing plant from 900 million lb to 1.1 billion lb next year. Formosa Plastics will add about 400 million lb to its capacity as it replaces an old plant with a new unit during the next two years. Other vinyl chloride producers may have projects under way, but they have not been announced publicly.

However, vinyl chloride producers were unable to fully utilize their capacity additions earlier this year. Preliminary data from the U.S. International Trade Commission show that ethylene dichloride production in this year's second quarter declined about 25 million lb from the first quarter to 3.32 billion lb at a time when demand pressure was especially high.

One reason behind this decline, and the subsequent decline in vinyl chloride and PVC output, was the limited availability of raw material ethylene. During the second quarter, several large steam crackers were shut down for varying lengths of time because of accidents or maintenance. Available ethylene went to uses that provided the largest returns, such as polyethylene manufacture. Therefore, ethylene dichloride and ethylene oxide production sometimes took secondary positions in terms of access to ethylene supplies.

Despite difficulties in getting raw materials, PVC producers are expanding capacity. Earlier this month, for example, Shintech Inc. completed a 500 million lb-per-year expansion at its Freeport, Tex., plant, bringing total capacity there to 1.5 billion lb. This expansion was completed more quickly than the original schedule, which called for half the capacity to be on stream late this year, with the rest coming next year. As this year's expansion was completed, another 500 million lb expansion for completion in 1990 was approved by Shintech's board of directors, according to Chihiro Kanagawa, president and chief executive officer.

Exports of PVC precursors outstrip exports of PVC

Millions of lb	Ethylene dichloride	Vinyl chloride	Polyvinyl chloride
1979	1137	1117	322
1980	612	872	465
1981	617	836	436
1982	796	927	566
1983	970	685	534
1984	759	1027	379
1985	973	1015	292
1986	583	1490	370
1987	953	844	430
1988[a]	930	630	480

a C&EN estimates based on January through August 1988 data.
Sources: Department of Commerce, Committee on Resin Statistics of the Society of the Plastics Industry

Many other PVC producers are adding capacity in smaller quantities. Prior to announcement of plans for the 1 billion lb-per-year vinyl chloride plant with Marubeni, Occidental had disclosed debottlenecking of its plants during 1987–88 and additional expansions to bring the company's capacity to about 2 billion lb of PVC per year. Other major producers, including Goodrich, Borden, CertainTeed, Georgia Gulf, Formosa, and Vista, have expansions either recently completed or under way for completion soon.

The various PVC capacity additions this year will total nearly 1 billion lb. At the beginning of 1989, in-place capacity will be about 9.4 billion lb for PVC, an increase of 12% for the year. Expansions during 1989 are forecast to be considerably less than in this year, probably ranging from 300 million to 400 million lb. Another 1 billion lb or more of capacity could be available in 1990.

If the PVC capacity can be operated as fully as is needed to meet sales and captive use requirements during 1989, production of PVC could increase 7 to 9%, considerably higher than the 5% increase in 1988 and nearly comparable to the growth in 1987. That could raise PVC production to about 8.9 billion lb in 1989. An economic downturn could foil such a gain, but most industry observers expect 1989 growth of at least half that rate, even if more output goes to exports. □